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F02B 75/04

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F2K K4B1B

(56) Documents Cited
GB 2249131 A GB 0346867 A GB 0228706 A
EP 0248655 A2 US 4401010 A US 4112826 A

(58) Field of Search
UK CL (Edition O) F1B
INT CL^6 F01B 31/14 , F02B 75/04

(54) Variable stroke and compression ratio engine

(57) The axis of the pivot 5 of a lever connecting a fixed throw crankshaft to a piston connecting rod 3 is movable axially Y along and perpendicularly X to the lever longitudinal axis.

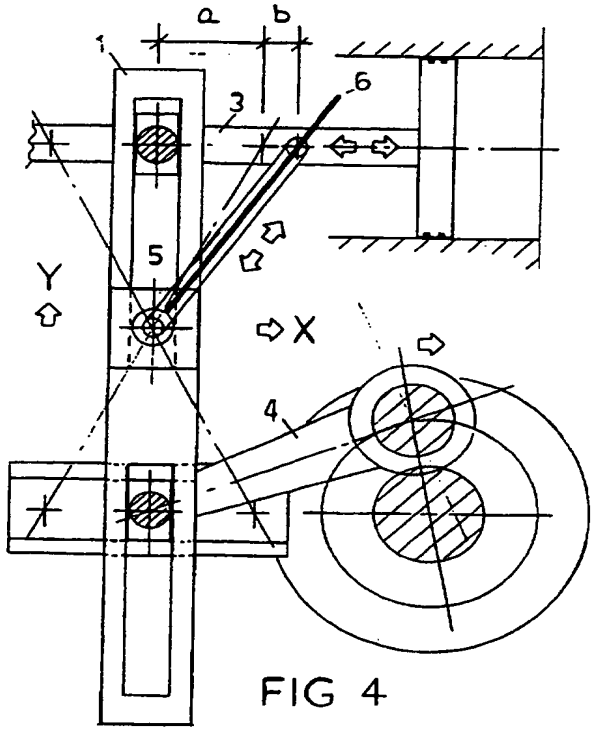

FIG 4

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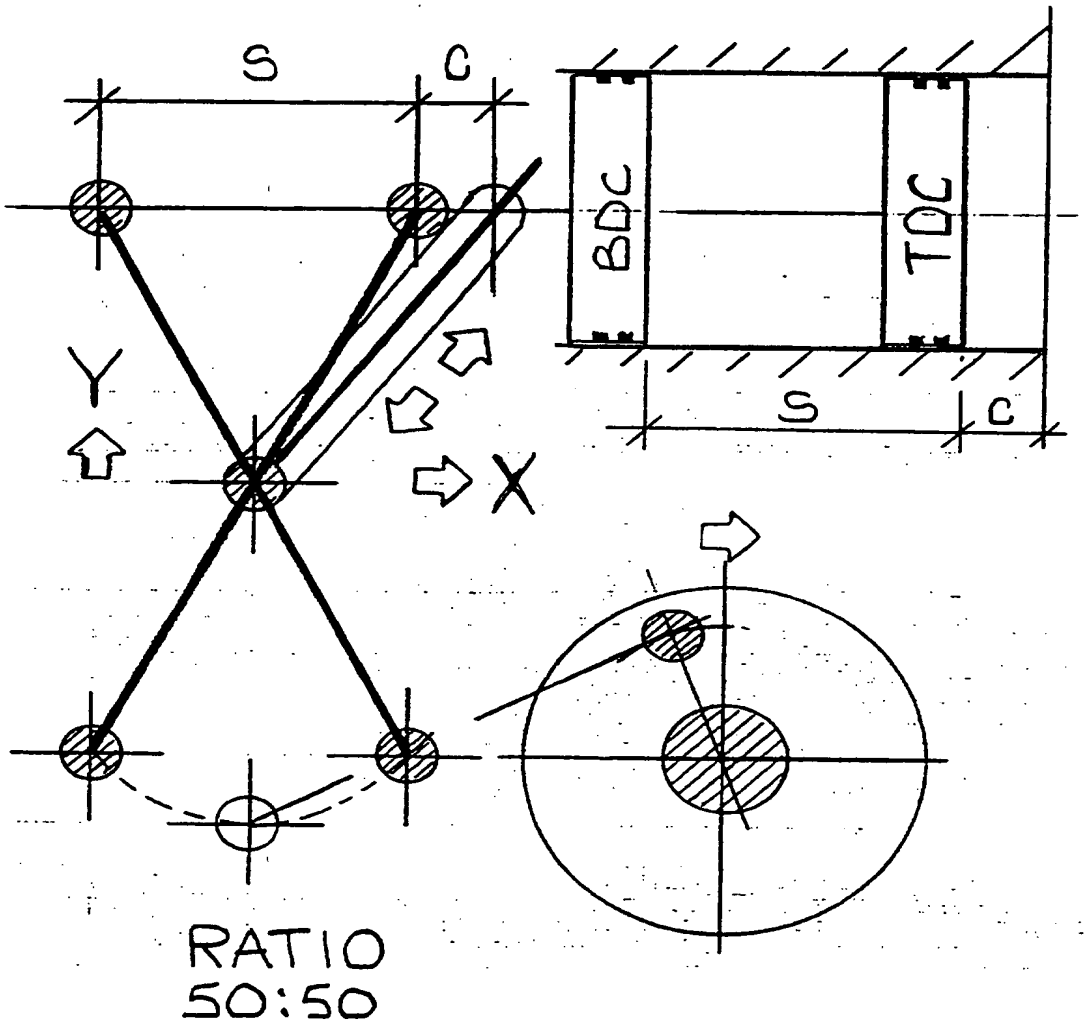


FIG 1

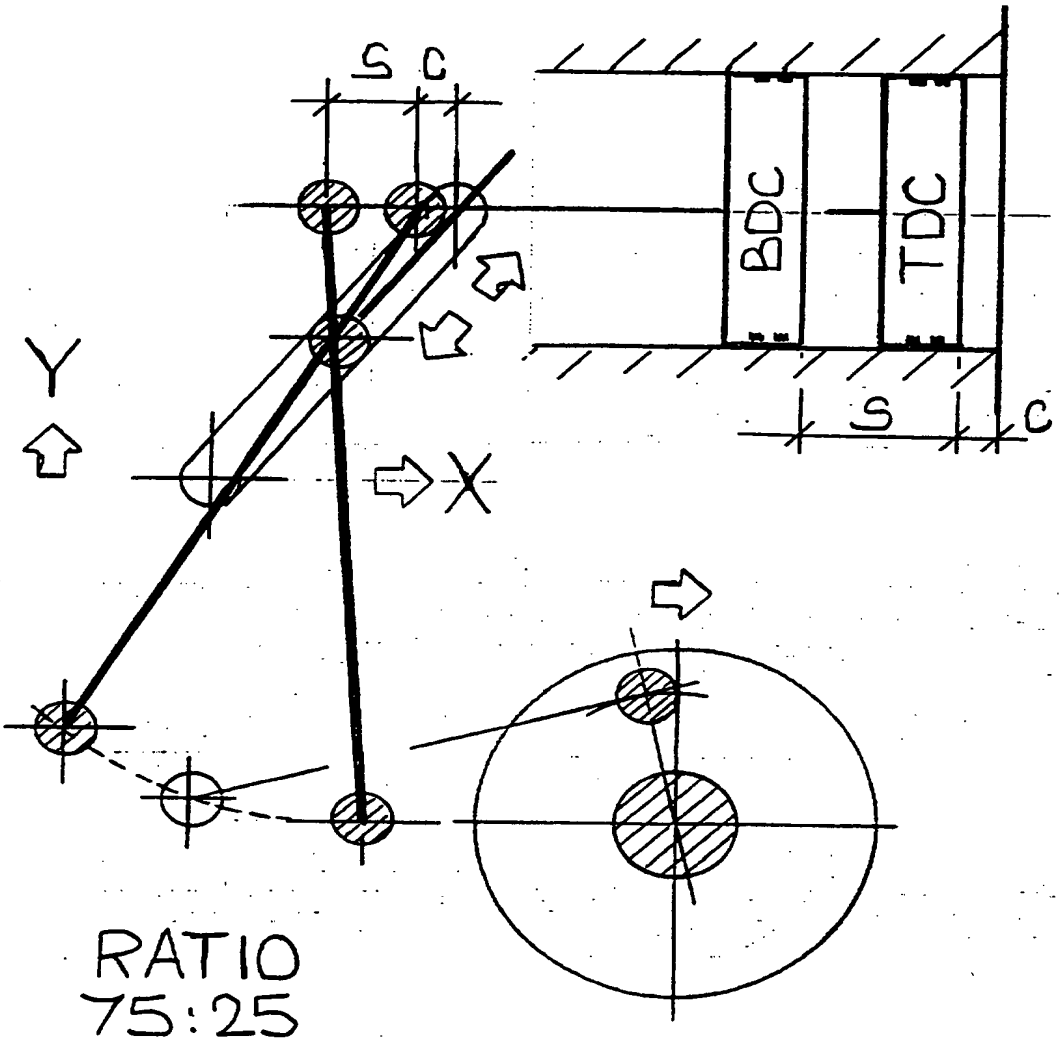


FIG 1

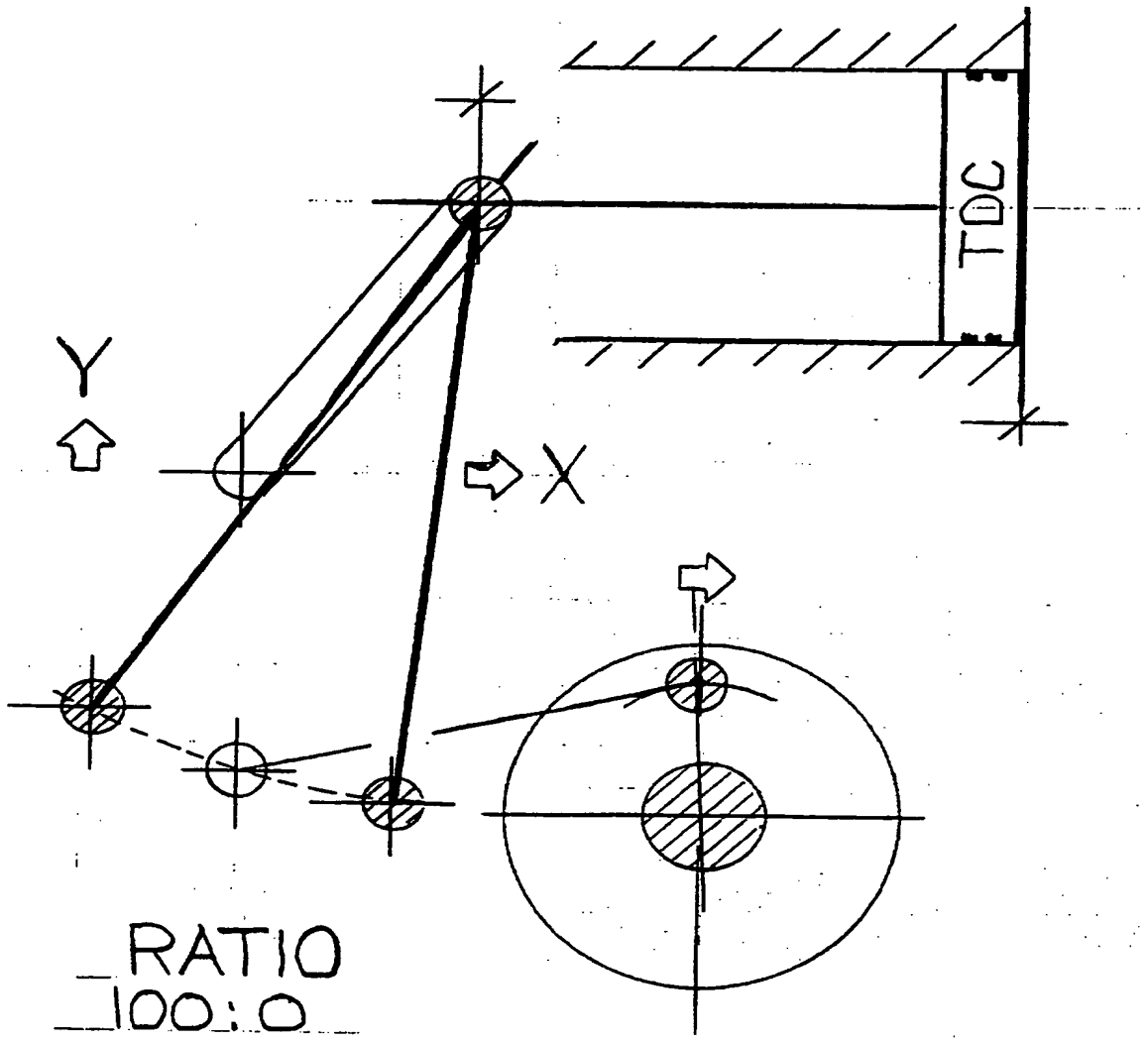


FIG 1

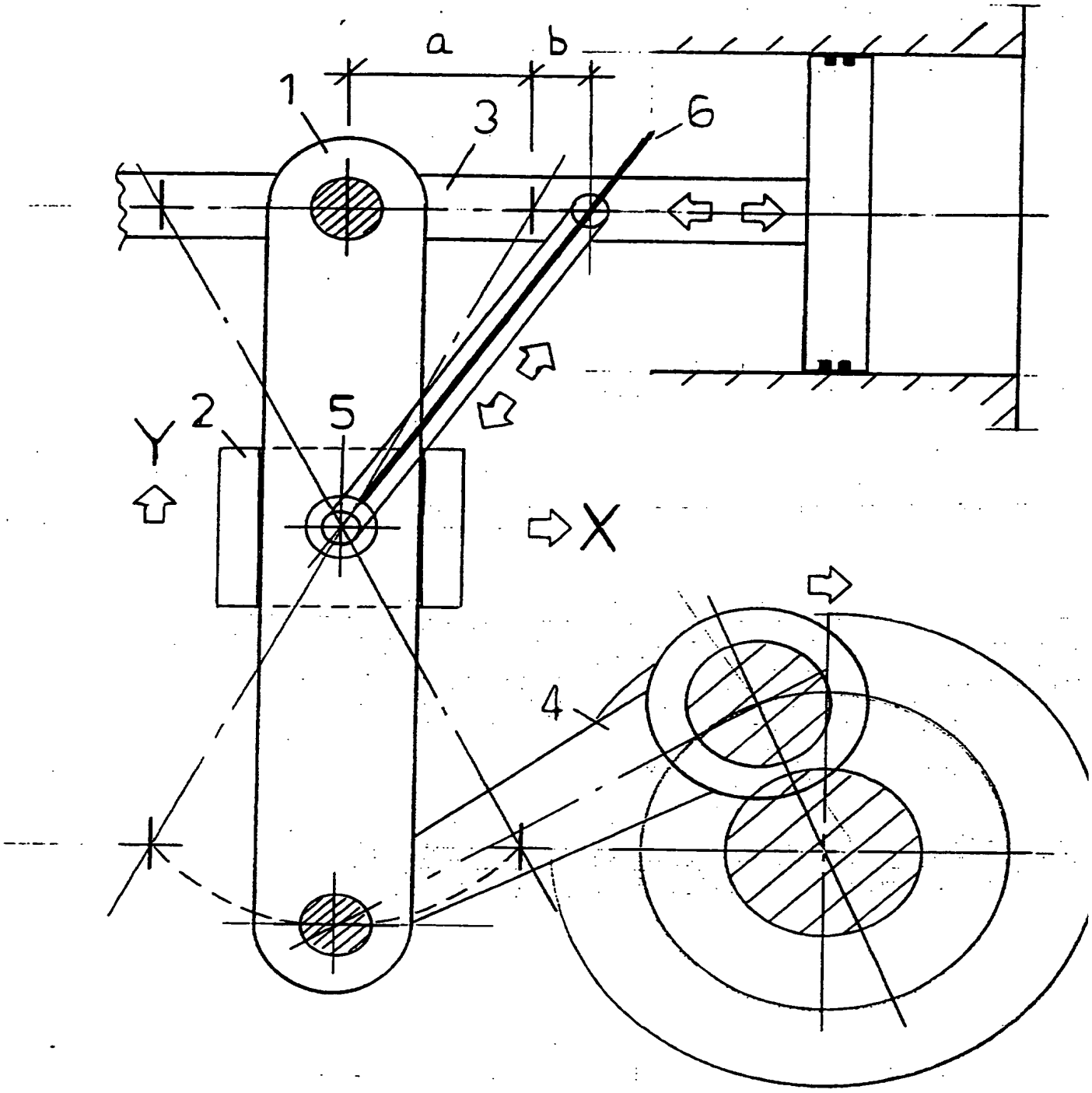


FIG 2

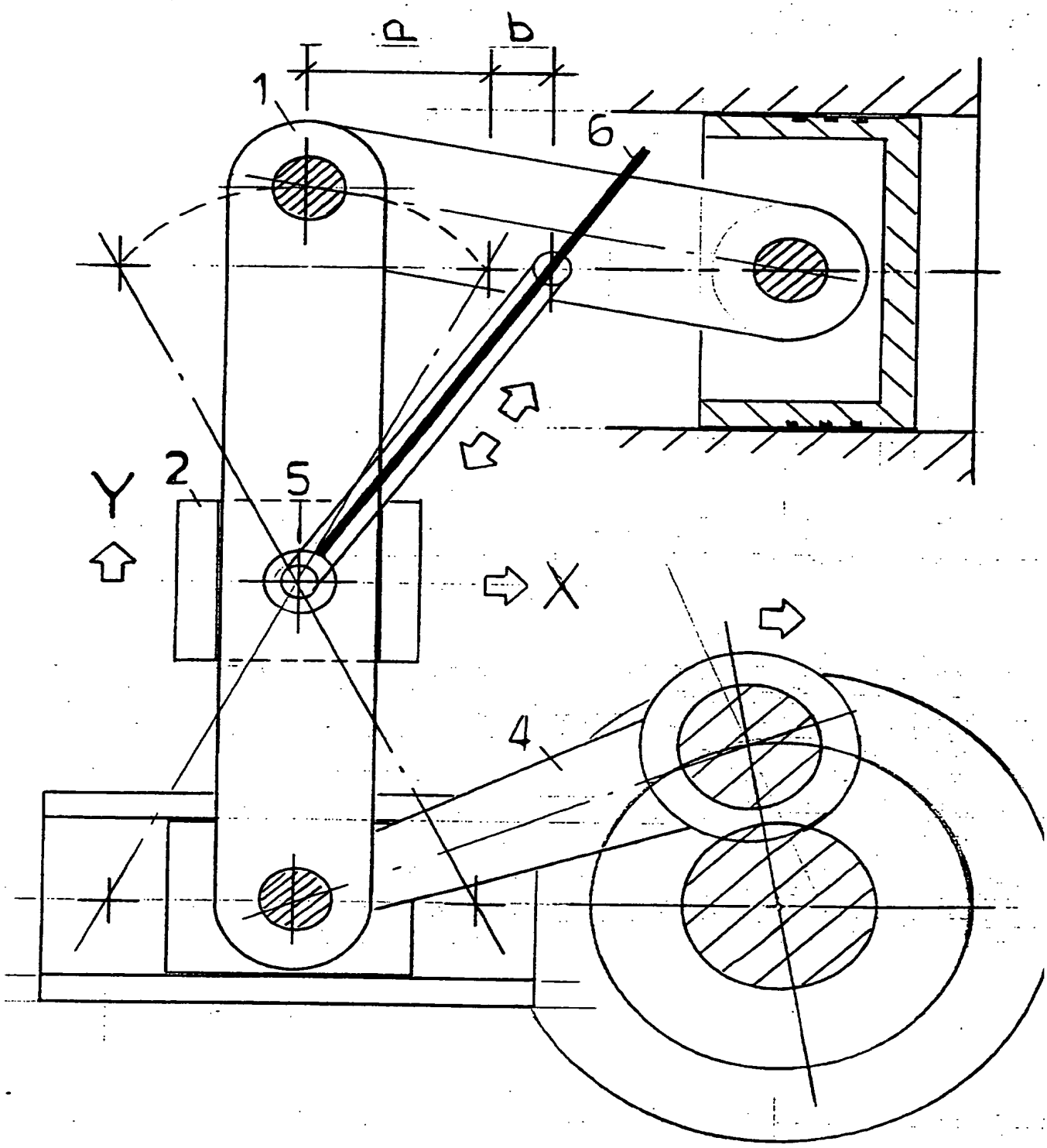


FIG 3

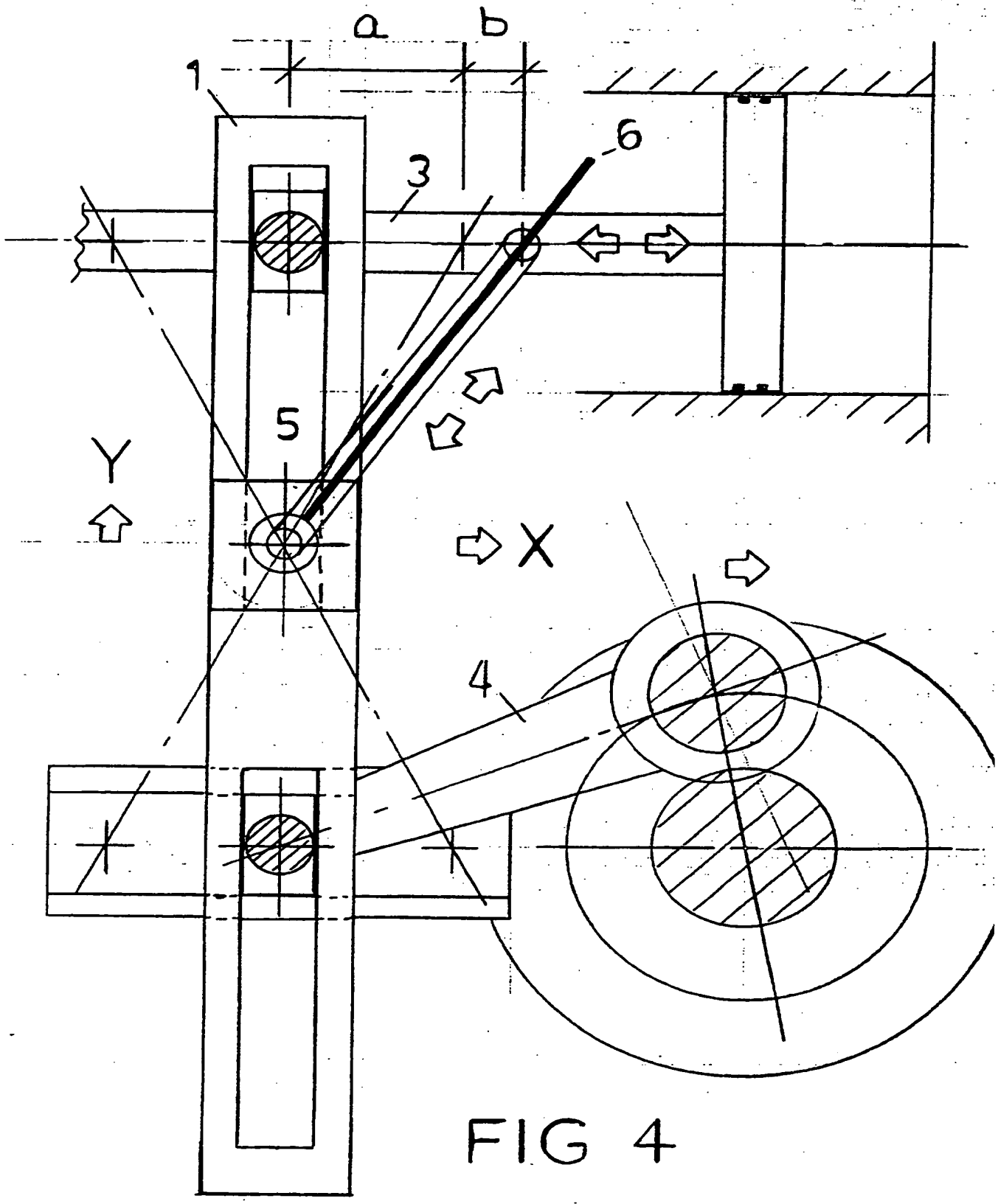
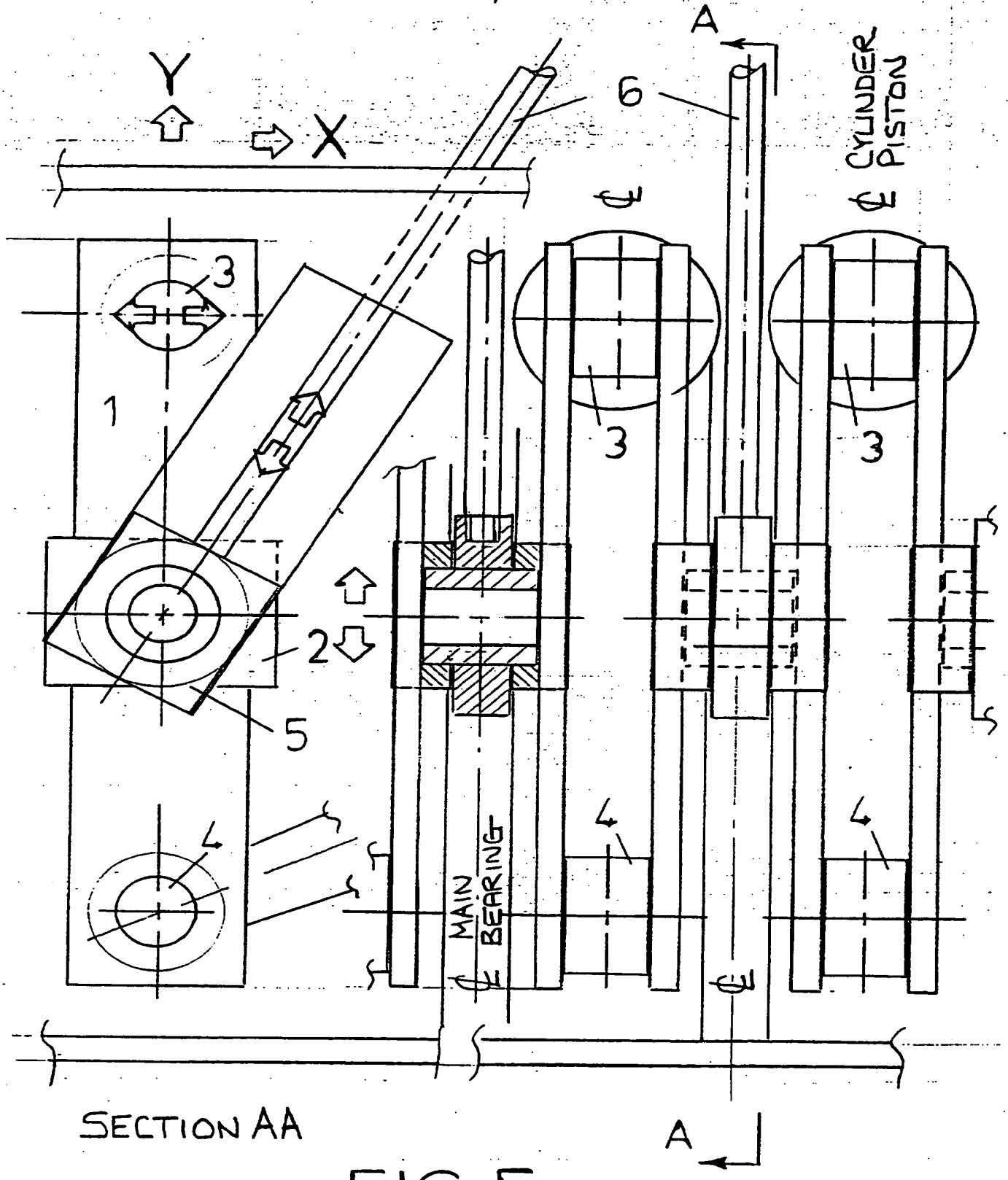


FIG 4



SECTION AA

FIG 5

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PATENT APPLICATION SPECIFICATION

1 Subject;
RECIPROCATING PISTON ENGINE MECHANISM

2 Scope;
A mechanism whereby the ratio of the piston stroke of a reciprocating piston engine can be varied from the fixed crankshaft throw.
The ratio can be varied in a continuous manner, from the maximum stroke, which need not be equal to the crankshaft throw, to a zero figure.
Means are also incorporated to maintain / adjust the compression pressures.

3 Introduction;
As applied to the internal combustion engine.

The present design of internal combustion engine has nearly reached its limit in efficiency in its present form. Any significant change in efficiency, must depend on a more radical design approach.

Basic engine design is generally determined by;
3.1 maximum power output - engine capacity - approx. 2% use
3.2 maximum compression ratio - full throttle - approx 3% use
3.3 part load - throttling inlet charge - approx 95% use

Items 3.1 and 3.2 produce maximum engine power / efficiency, and item 3.3 decreases efficiency. This decrease becomes larger as the throttling increases.

Clearly throttling is an extremely inefficient method of engine control, and is employed for the majority of the engine running time.
The decrease in efficiency is caused by the lowering of the achieved Compression Ratio (CR) and the increased pumping losses.
The criteria for improvement are therefore;
a) avoid throttling or minimise, at part load running conditions
b) retain the maximum amount of existing engine design, components and manufacturing equipment

In order to avoid throttling of the inlet charge the engine must be run at full power. To reduce this amount of power to the level required by the vehicle in the lower speed ranges efficiently, the amount of inlet charge must be reduced. This can only be achieved by reducing the engine capacity in a stepless manner ie. piston stroke. Providing the CR can be maintained at the required figure, this is a very effective method, as it allows the engine to operate in a much improved Specific Fuel Consumption range, with reductions in:-
a) piston and ring friction

b) heat loss to the cylinder wall
c) induction and exhaust pumping losses
d) exhaust gas quantity
as these items are proportional to stroke.

4 DESIGN
4.1 BASIC PRINCIPLE see Fig 1 sheets 1 to 3

The purpose of the following mechanism is to extend the development of the well established existing reciprocating piston engine. The modifications to the layout of cylinder to crankshaft being self explanatory.

By introducing a Rocking Lever with a Movable Pivot such that the length ratio between the pivot and piston, and the pivot and crankshaft, can be varied, we can alter the ratio of the piston stroke to that of the fixed crankshaft throw.

As the Movable Pivot is also located in a Movable Guide Block, see fig 5, it can be seen that:-
a) movement of the guide block in the Y AXIS varies the lever length ratios
b) movement of the guide block in the X AXIS varies the location of the piston in the cylinder.

4.2 DESIGN VARIATIONS

4.2.1 Piston guided - fig 2; lever fixed in Y AXIS at piston end
4.2.2 Con-rod guided - fig 3; lever fixed in Y AXIS at crank end
4.2.3 Piston and Con-rod guided - fig 4 lever free to move with Movable Guide Block - weight transfer of lever to compensate engine balance at reduced strokes
4.2.4 Movable Guide Block - independent X and Y AXIS movement
4.2.5 Movable Guide Block - combined X and Y AXIS movement

4.3 DESIGN DESCRIPTION

Design Variation 4.2.1 and 4.2.5 see Fig 2
ie piston guided and combined X and Y axis movement

The engine arrangement consists of two main elements

4.3.1 Engine block - this represents present day engine technology with the piston / cylinder axis being transferred from the Y AXIS to X AXIS

4.3.2 Lever mechanism - arrangement whereby the the variations to stroke and piston location are carried out.

The following parts / nomenclature being used

1 ROCKING LEVER - with integral / separate guide system
note - fig 4 lever extended for engine balance purposes
2 MOVABLE PIVOT / HOUSING - figs 2 and 3 - may be asymmetric weighted to compensate engine balance at reduced strokes
3 EXTENDED PISTON ROD / GUIDE system
4 CONNECTING ROD
5 MOVABLE GUIDE BLOCK / FULCRUM PIVOT system
6 OPERATING ROD - to connect to engine control system
7 PIVOT GUIDE SHOES - fig 4 only

The arrangement is made up of three separate functions

4.3.3 Piston to crankshaft movement transfer
4.3.4 Piston to crankshaft movement variations
4.3.5 Piston location in cylinder variations

4.3.3 by the introduction of a ROCKING LEVER 1 with a MOVABLE PIVOT / HOUSING 2 , between a EXTENDED PISTON ROD GUIDE 3 , and the CONNECTING ROD 4 , little end.
Assume the MP/H 2 is at the mid point of RL 1 and fixed. The fixed crank throw movement is transferred via RL 1 into an equal but opposite movement at the piston.

4.3.4 by moving MSH 2 in the Y AXIS along RL 1 the ratio of the arm leverage can be varied from the maximum to zero.
By providing a MOVABLE GUIDE BLOCK / FULCRUM PIVOT 5 in the Y AXIS , which is controlled by OPERATING ROD 6 , movement of OR 6, moves MGB/FP 5, moves MP/H 2, which varies the arm ratio, and thus, the piston stroke to the fixed crank throw.

4.3.5 if however MGB/FP 5 axis is offset in the X AXIS direction, at the piston end;
a) by an amount equal to half the maximum piston stroke, the piston Top Dead Centre location in the cylinder remains unchanged.
b) by a further amount the compression pressure can be maintained / compensated for.
The sum of the two offsets provide the Guide Path line, for MGB/FP 5.

4.3.6 the above system may be fitted singly; paired; or with shared components, between cylinders; or by any combination thereof.

5 CLAIMS

5.1 A mechanical arrangement, which can be incorporated into the basic design of conventional reciprocating piston engines, which enables;
a) The piston stroke of a reciprocating piston engine with a fixed crankshaft throw, to be varied in a continuous manner from the maximum stroke, which need not necessary be equal to the crankshaft throw, to zero.

b) The piston location in the cylinder to be varied.

These movements maybe carried out as separate individual movements or in a combined manner.

5.2 As 5.1 with mechanical arrangement such that the ROCKING LEVER 1 is restrained in the Y AXIS by a guided piston rod assembly

5.3 As 5.1 with mechanical arrangement such that the ROCKING LEVER 1 is restrained in the Y AXIS by a guided connecting rod assembly

5.4 As 5.1 + 5.2 and 5.3 with mechanical arrangement such that the ROCKING LEVER 1 is free to move in the Y AXIS with the MOVABLE GUIDE BLOCK / FULCRUM PIVOT 5. GUIDE SHOES 7 being incorporated with the end pivot bearings.

5.5 As 5.1 to 5.4 with MGB/FP 5 movement with independent control in the X and Y AXIS.

5.6 As 5.1 to 5.4 with MGB/FP 5 movement with combined X and Y AXIS control.

The Patent Office

5

Application No: GB 9608185.6 **Examiner:** Roger Dennis
Claims searched: 1-6 **Date of search:** 3 June 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F1B

Int Cl (Ed.6): F01B 31/14 F02B 75/04

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2249131 A	(FORD)	1
X	GB 0346867	(FANSHAWE) See particularly lines 26-37,page 2.	1-6
X	GB 0228706	(TACCHI)	1
X	EP 0248655 A2	(THE TRUSTEES)	1
X	US 4401010	(EDDINGTON)	1
X	US 4112826	(GENERAL MOTORS)	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.